Automated, Ubiquitous Delivery of Generalised Services in an Open Market

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A Dissertation Submitted for the Degree of
Doctor of Philosophy in Computing Science
at the
University of Technology, Sydney

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Sydney, Australia

2007

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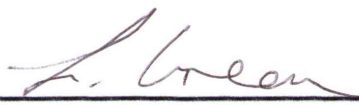

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To my wife, for everything...

Acknowledgements

My doctoral research culminating in the following dissertation was a long and involved process. There are many people to thank for their help and support during this time:

First and foremost to my supervisor John Debenham for his energy and attitude, maintaining an enjoyable research process throughout my candidature. John helped greatly with my technical writing and clarification of ideas, essential to this dissertation. The comments provided on multiple chapter drafts were most helpful!

To my wife, Iris for the motivation and emotional support throughout the more difficult times. Along with my family and friends, your help to keep me grounded in the real world while my mind was elsewhere was invaluable.

Many thanks to all my colleagues from the Alcatel Collaboration, both in Sydney and France. The ability to base my research on a real industry problem, and receive guidance and feedback was essential.

To my co-supervisor Simeon Simoff, fellow red-square denizens and colleagues within the E-Markets research group, especially Paul Bogg, whom I consulted on numerous occasions. I thank you all for the help you have provided along the way.

A big thankyou to my good friend Denn, who helped me by proof reading this document.

Finally, to the Institute of Information and Communication Technologies (IICT), Alcatel and the Australian Research Council. Without your generous financial support my candidature would have been far more difficult, if not impossible.

This work has been performed as part of an Australian Research Council Linkage Grant, LP0560935 between Alcatel and the University of Technology, Sydney. The project title is: Managing **Q**uality of Experience **D**elivery **I**n **N**ew Generation Telecommunication Networks with **E**-negotiation **(QDINE)**.

Abstract

Telecommunications networks, and the services delivered over those networks have become an integral part of most people's lives in the developed world. The range and availability of these services is increasing, however the management of services still lags well behind technical capability, providing unnecessary barriers to the adoption of available technology. The work described in this dissertation has a primary goal of enabling flexible, automated delivery of any telecommunication-based service. More specifically, a mechanism to solve the administrative problems in enabling end users to automatically establish service agreements for any available service, from any available provider.

The aims of this work are to:

1. enable the description of service level agreements(SLA) for generalised telecommunication-based services, and
2. provide mechanisms by which those service level agreements may be managed.

The term "generalised services" means that all service types are managed using a common framework and set of processes.

To derive at a suitable service level agreement description language, the characteristics of telecommunication-based services are first analysed, along with considerations in delivering a service, including service quality, resource allocation and configuration, service pricing and service ubiquity. The current art in SLA description is studied and the requirements of an appropriate language are proposed. An ontological approach to SLA description is adopted, and an SLA description language is developed based on semantic web technologies.

To develop the mechanisms for SLA management, the current art is first analysed, and a set of requirements for a suitable SLA management framework are proposed. These requirements are used to guide the design of a multi-agent SLA negotiation framework, including a detailed description of the communication model, framework processes, and social behaviour of the agents involved.

Finally, the SLA description language and the negotiation framework are compared with the closest art, and are assessed against tightly argued criteria. An experimental

framework and use cases are developed to explore an application of the proposed solution, and to validate completeness.

The approach taken has led to the following two key contributions:

1. A set of formal ontologies that may be used to semantically describe secure service level agreements for any application domain.
2. A multi-agent system providing an open market where services can be discovered, participants identified, and negotiation performed using context specific mechanisms.

The conclusions of the work are that an ontology-based SLA description language is appropriate for describing generalised SLAs, and that a distributed, agent based negotiation platform that is based on an open market and uses a minimal set of core processes with an extensible, ontology based communication mechanism is appropriate for managing service level agreements in a generalised, automated and ubiquitous way.

Table of Contents

List of Figures

List of Tables

List of Symbols

α - Agent acting in Market Agent role

β - Agent acting in Service Provider role

γ - Agent acting in Consumer role

δ - Agent acting in Billing Provider role

ϵ - Agent acting in Subscriber role

ζ - A QDINE agent

κ - A service

λ - Message content language

μ - FIPA message payload

π - Agent state in a protocol

ρ - Interaction Protocol

ϱ - An agent role

σ - Message Reply identifier

τ - Message Reply-By time

ϕ - Performative

φ - Root message content individual

χ - Message payload content

ψ - Conversation

ω - Ontology

A - Set of all agents acting in the Market Agent role

B - Set of all agents acting in the Service Provider role

Γ - Set of all agents acting in the Consumer role

E - Set of all agents acting in the Subscriber role

Z - Set of all QDINE agents